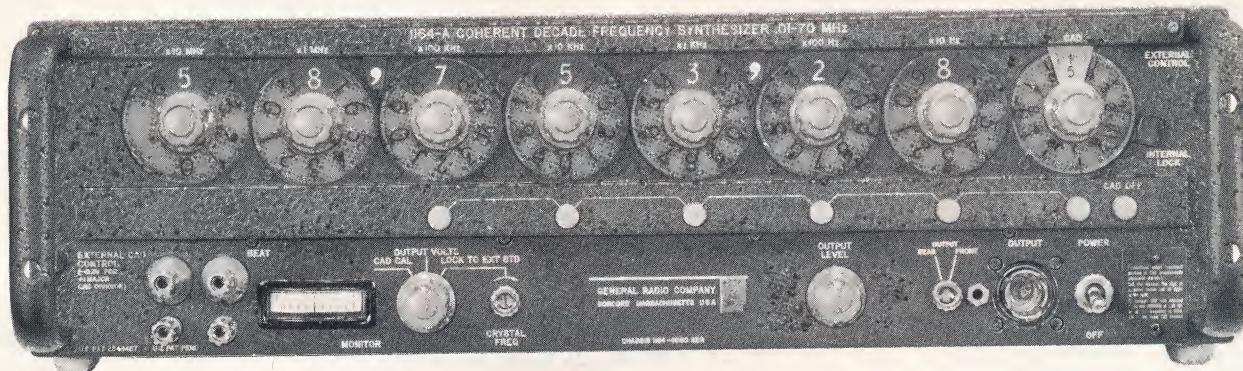




NEW 70-MHz Solid-State Synthesizer

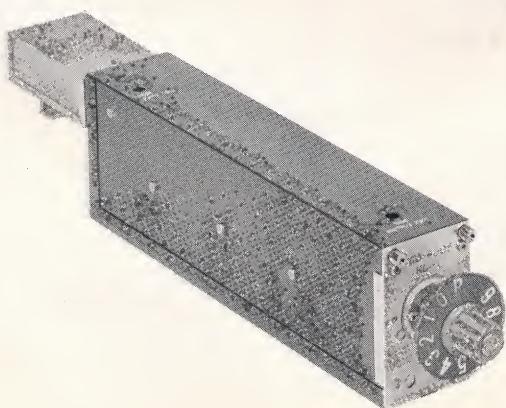
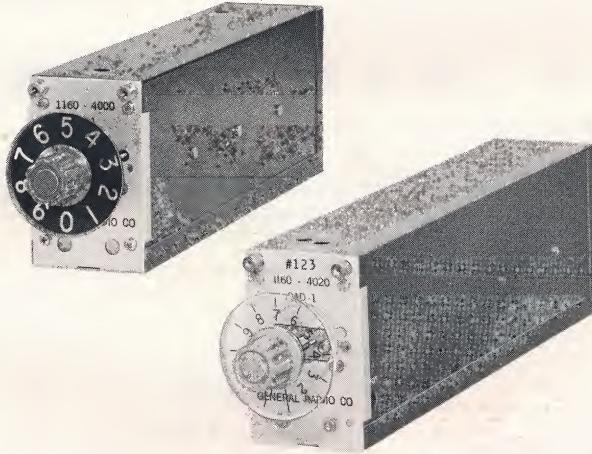


Available in 20 versions. Output adjustable up to 2 volts at accurately known, stable, sine-wave frequencies. 7-digit readout plus continuous frequency control. Signals are coherently synthesized from internal quartz-crystal oscillator. Plug-in modules give you choice of resolution: 10 Hz, 100 Hz, 1 kHz, and 100 kHz, or to better than 0.1 Hz with a continuously adjustable decade.

Basic Synthesizer Modules

• The DI-1 Unit

Digit-Insertion Module provides discrete frequency steps. This module is used for all digit decades except the 1-MHz and 10-MHz per-step positions.



• The CAD Unit

Continuously Adjustable Decade provides either continuous, manual control of frequency or sweep-frequency coverage of selected sections of the instrument's range up to bandwidths of 1 MHz. It can also readily be calibrated against DI-1 Units to provide additional resolution.

• The RDI-1 Unit

Remotely Programmable Digit-Insertion Module, used in place of the DI-1 Unit, converts the Synthesizer for programmed operation at any or all DI-1 stations. The RDI-1 Unit accepts either a biquinary or 10-line coded program or can be used manually when the dial is turned from the programmable "R" position to the desired digit. A plug is provided at the rear of the module for the programming signal.

SPECIFICATIONS

Frequency Range: 10 kHz to 70 MHz.

Smallest Digital Step: 10 Hz.

Smallest Direct-Reading CAD Increment (A7C model): 0.1 Hz.

Maximum Bandwidth Controllable by CAD: 1.2 MHz.

Maximum Programmable Bandwidth:** 1 MHz.

Spurious Frequency Outputs: Harmonic (at max output), <-30 dB. Nonharmonic, <-60 dB.

Output: 0 to 2 V, rms; metered; behind 50Ω; flat within 0.3 dB from 10 kHz to 70 MHz, available at either front or rear.

Auxiliary Outputs (at rear): Primary outlets, 100 kHz and 5 MHz (0.5 V, rms, min, across 50Ω). Secondary outlets, low-level, high-impedance, 0.1 V, min, across 1 kΩ: 1 MHz, 5 MHz, 5/5.1 MHz, 30 MHz, 42 MHz, 50/51 MHz, 90 MHz,

and +18 V, dc (test point). BEAT output and EXT CAD CONTROL input also duplicated at rear.

Operating Temperature Range: 0 to 50°C.

Internal Frequency Standard: Room-temperature, quartz-crystal oscillator. Temperature coefficient of frequency is typically less than $2 \times 10^{-7}/\text{C}$ from 20°C to 50°C. A front-panel frequency adjustment is provided. Crystal can easily be phase-locked to an external standard.

Lock Signal Input from external standard (if used): 0.25 V, rms, to 5 V, rms, 5 MHz, or any submultiple down to 100 kHz. Input impedance is approximately 1 kΩ for low-level signals, drops to approximately 50Ω effective at high levels.

Power Required: 105 to 125, 195 to 235, or 210 to 250 V, 50 to 400 Hz, 55 W; or 20 to 28 V, dc, 1.8 A.

CALIBRATED DIGITS

PROGRAMMABLE/MANUAL MODELS**

| Type | Units Included | DI Decades Only | DI Decades + CAD* | Smallest Step (DI Only) | Price | Type | Smallest Programmable Increment | Price |
|----------|------------------|-----------------------|-------------------------|-------------------------------|----------|-----------|---------------------------------------|----------|
| 1164-A7C | 7 DI Units + CAD | 7 | 9 | 10 Hz | 6,600.00 | 1164-AR7C | 10 Hz | 7,025.00 |
| 1164-A6C | 6 DI Units + CAD | 6 | 8 | 100 Hz | 6,160.00 | 1164-AR6C | 100 Hz | 6,500.00 |
| 1164-A5C | 5 DI Units + CAD | 5 | 7 | 1 kHz | 5,720.00 | 1164-AR5C | 1 kHz | 5,975.00 |
| 1164-A4C | 4 DI Units + CAD | 4 | 6 | 10 kHz | 5,280.00 | 1164-AR4C | 10 kHz | 5,450.00 |
| 1164-A3C | 3 DI Units + CAD | 3 | 5 | 100 kHz | 4,840.00 | 1164-AR3C | 100 kHz | 4,925.00 |
| 1164-A7 | 7 DI Units | 7 | | 10 Hz | 6,100.00 | 1164-AR7 | 10 Hz | 6,525.00 |
| 1164-A6 | 6 DI Units | 6 | | 100 Hz | 5,660.00 | 1164-AR6 | 100 Hz | 6,000.00 |
| 1164-A5 | 5 DI Units | 5 | | 1 kHz | 5,220.00 | 1164-AR5 | 1 kHz | 5,475.00 |
| 1164-A4 | 4 DI Units | 4 | | 10 kHz | 4,780.00 | 1164-AR4 | 10 kHz | 4,950.00 |
| 1164-A3 | 3 DI Units | 3 | | 100 kHz | 4,340.00 | 1164-AR3 | 100 kHz | 4,425.00 |

*Direct Reading. If CAD is calibrated in terms of the DI step decades, at least one more significant figure can be added.

**The X10 MHz and X1 MHz decade units are not programmable. However, these two decades can be programmed between whole 1-MHz steps (for example, between 11 and 12 MHz, 25 and 26 MHz, 59 and 60 MHz, etc.).

GENERAL RADIO COMPANY

West Concord, Massachusetts 01781

- NEW ENGLAND
22 Baker Avenue
West Concord, Massachusetts 01781
- METROPOLITAN NEW YORK
Broad Avenue at Linden
Ridgefield, New Jersey 07657
- SYRACUSE
Pickard Building, East Molloy Rd.
Syracuse, New York 13211
- PHILADELPHIA
Fort Washington Industrial Park
Fort Washington, Pennsylvania 19034
- WASHINGTON and BALTIMORE
11420 Rockville Pike
Rockville, Maryland 20852
- CHICAGO
6605 West North Avenue
Oak Park, Illinois 60302
- CLEVELAND
5579 Pearl Road
Cleveland, Ohio 44129
- ORLANDO
113 East Colonial Drive
Orlando, Florida 32801
- DALLAS
2600 Stemmons Freeway, Suite 210
Dallas, Texas 75207
- SAN FRANCISCO
626 San Antonio Road
Mountain View, California 94040
- LOS ANGELES
1000 North Seward Street
Los Angeles, California 90038
- TORONTO
99 Floral Parkway
Toronto 15, Ontario, Canada
- MONTREAL
1255 Laird Boulevard
Town of Mt. Royal, Quebec, Canada

GENERAL RADIO COMPANY (OVERSEAS), 8008 Zurich, Switzerland

GENERAL RADIO COMPANY (U.K.) LIMITED, Bourne End, Buckinghamshire, England

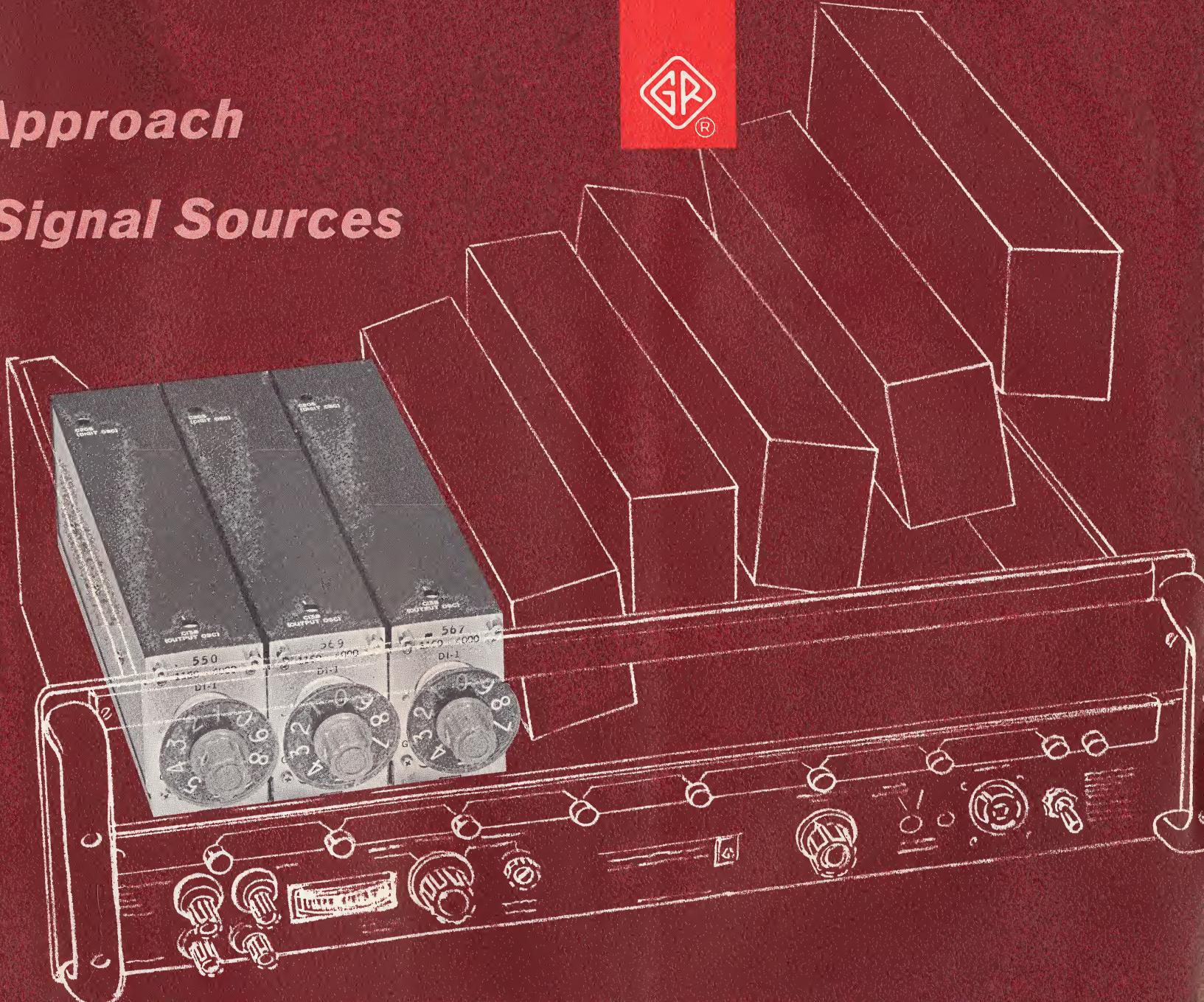
REPRESENTATIVES IN PRINCIPAL OVERSEAS COUNTRIES

A New Approach
in Signal Sources



MODULAR

All Solid State



Decade Frequency Synthesizers

New MODULAR FREQUENCY SYNTHESIZERS

...Provide

30 c/s to 12 Mc/s

in Twenty Type 1163 Models

DC to 1 Mc/s

in Twenty Type 1162 Models

DC to 100 Kc/s

in Twenty Type 1161 Models

Buy Only the Resolution You Need

Add More Later, If You Wish

... Even Remote Programming Capability

These new instruments bring the building-block concept to frequency synthesizers. Now you can obtain a synthesizer with the resolution you need at a reasonable price — and, at any time you can increase resolution capability with the addition of new modules.

The heart of this new Synthesizer is a plug-in module called a Digit-Insertion Unit (DI unit). Up to seven of these units can be assembled in a frame to produce a decade-frequency synthesizer with in-line readout. You can start with as few as three Digit-Insertion Units to form a working synthesizer — a 100-kc model adjustable in 100-cycle steps, or a 1-Mc model with 1-kc steps. The 12-Mc model, adjustable in 10-kc steps, includes two DI Units plus a 1-Mc-step module (DI-4 Unit), that differs from the DI Unit. Add another DI Unit, and the 100-kc model now has 10-cycle resolution, the 1-Mc model goes down to 100 c/s, and the 12-Mc model goes down to 1 kc/s. Put in the remaining DI Units and you get 0.01-cycle resolution all the way to 100 kc/s, 0.1-cycle increments to 1 Mc/s, or 1-cycle increments to 12 Mc/s (30-cycle lower limit).

These are the Basic Synthesizer Modules



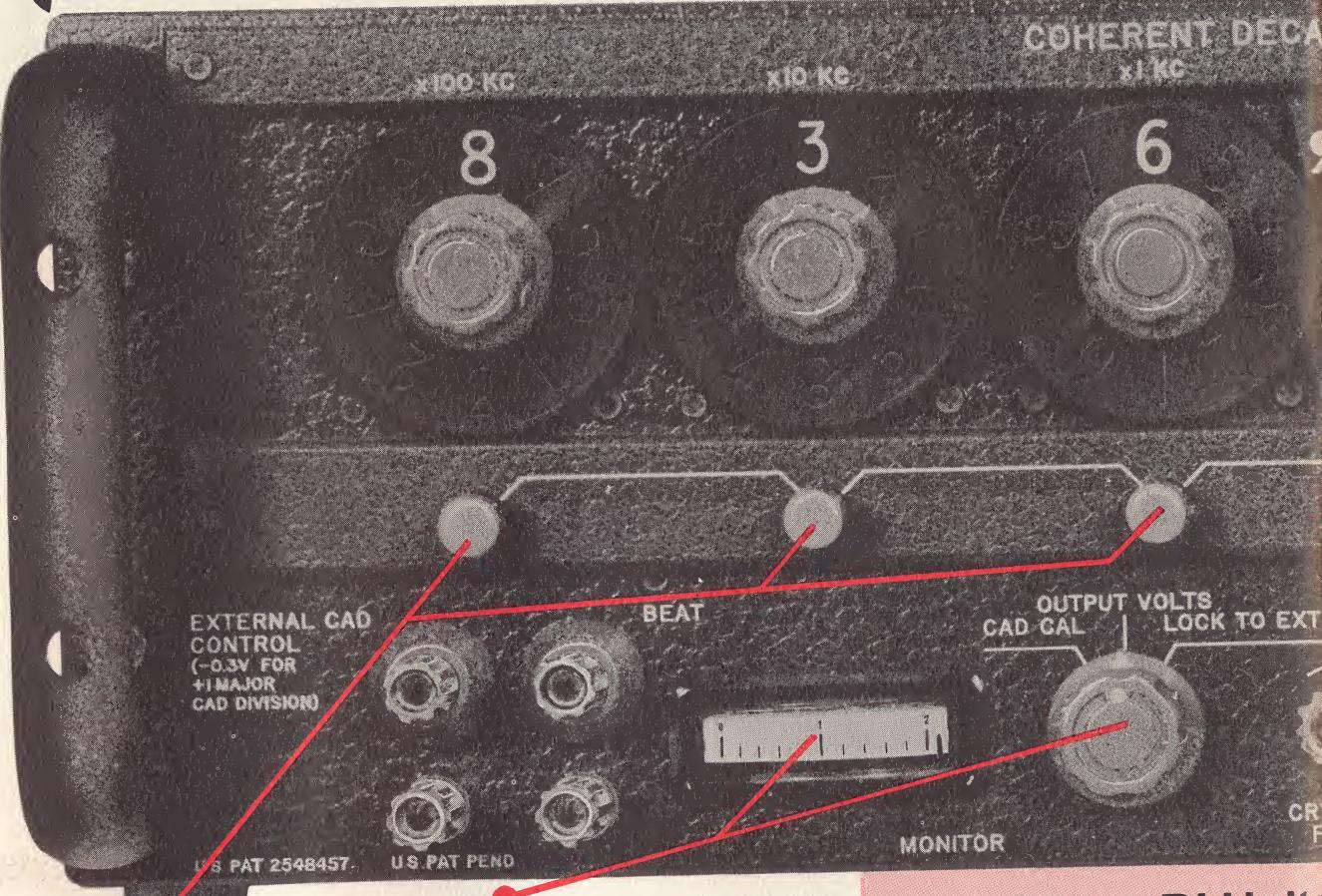
The DI Unit

(Digit-Insertion Module) provides discrete frequency steps. This module is used for all digit decades except for the 1-Mc step position in Type 1163-A.



The CAD Unit

(Continuously Adjustable Decade) provides either continuous, manual control of frequency or sweep-frequency coverage of selected sections of the instrument's range up to 1 Mc/s. It can also be calibrated against DI Units to provide additional resolution.



Illuminated Dials provide in-line readout of the synthesized frequency.

These pushbuttons permit replacement by CAD Unit.

When set to OUTPUT VOLTS, meter range is 0-2 volts, rms.

LOCK TO EXT STD — When a locking signal is introduced at the rear of the Synthesizer, the meter will verify that the internal crystal oscillator is locked to the standard.

CAD CAL position is for calibration of the Continuously Adjustable Decade, against the digit decades.

With Three DI Units

Shown: Type 1162-A

adjustable

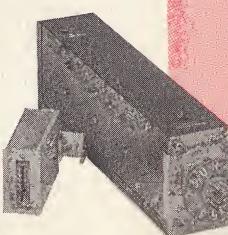
Comparable Type 1161-A

adjustable

or Type 1163-A

adjustable

Above Units w/



The RDI Unit

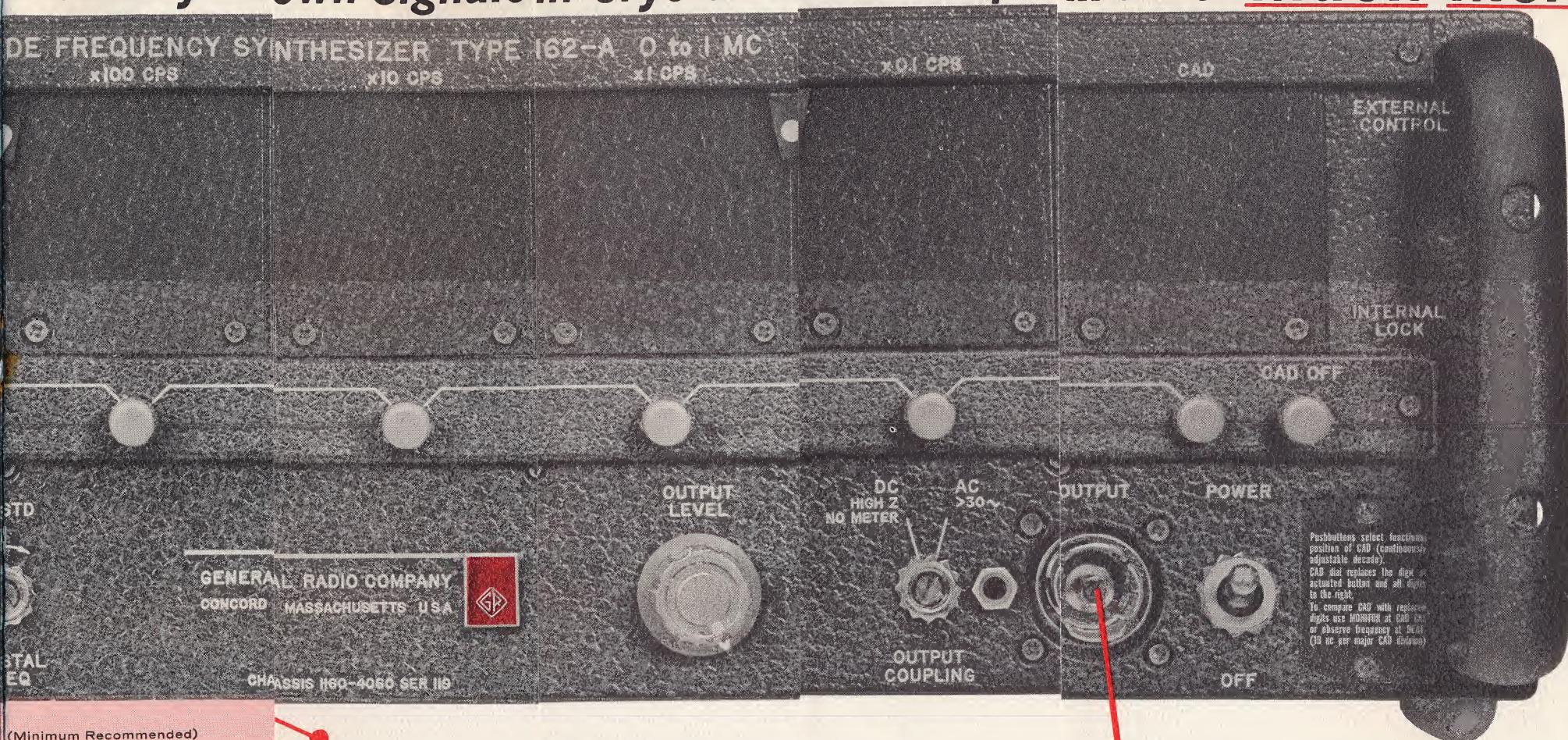
(Remotely Programmable Digit Insertion Module) used in place of the DI Unit, converts the Synthesizer for either partial or fully programmed operation. The RDI Unit accepts either a biquinary or 10-line coded program, or can be used manually by simply turning the dial from the programmable "R" position to the desired digit. A plug is provided at the rear of the module for the programming signal.



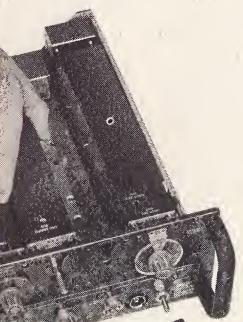
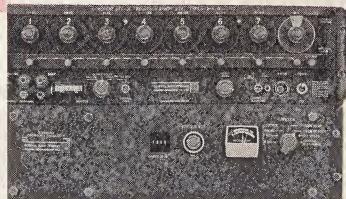
The DI-4 Unit

The 1-Mc-per-step module used in the Type 1163-A Synthesizer has 12 positions with an upper

Precisely Known Signals in Crystal-Locked Steps ... and Much More



VERNIER CONTROL makes possible the adjustment of the free-running frequency of the internal master 5-Mc crystal oscillator against an external standard. Synthesizer can also be locked to an external standard.



The next figure shows four DI Units selected as indicated, and the signal through the train, from right to left. The difference between the signal component from Unit A (24.39 kc/s) and the 2439. It is clear that the output Unit in such a train of DI Units is, in kc/s:

$$d_2 + 0.1d_3 + 0.01d_4 + \dots \quad (5)$$

The selected digit on the engaged to the left, and d_2 through d_4 represent successive DI Units to the right. This is the two fundamental operations signal component by each DI Unit, frequency synthesis in steps as small as these operations are: multiply signal component by 10. Digit component that is 10 times the c/s) and pass the result on to the Unit in the train.

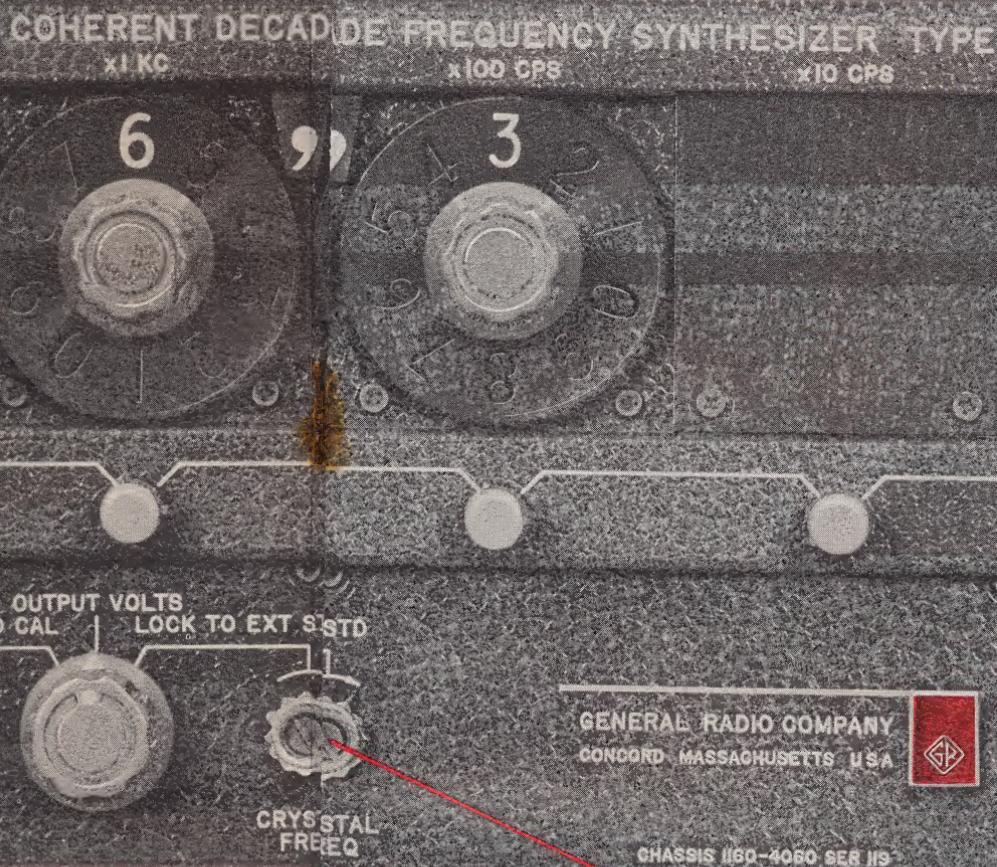
Output, when ac-coupled, is flat within ± 1 dB from 30 c/s to 1 Mc/s, 30 c/s to 100 kc/s for 1161-A models; $\pm 1\frac{1}{2}$ dB from 30 c/s to 12 Mc/s for 1163-A models. Output impedance is 5 ohms, and available output voltage into loads of 50 ohms or higher is in excess of 2 volts, rms. In dc-coupled condition (1161-A and 1162-A only) output impedance is variable from 0 to 3 kilohms, depending on level-control setting. Available open-circuit output voltage is approximately 1 volt.

Please Lift This Flap

To learn more about how versatile this Synthesizer can be with calibrated continuous tuning.

limit of 11 Mc/s and is not replaceable with DI Units, nor is it programmable. In all other respects, however, the Type 1163-A 12-Mc Synthesizer is similar to the other models.

...Provide Precisely Known Signals



Four DI Units

Shown above: Type 1162-A4
adjustable

Comparable Type 1161-A4
adjustable
or Type 1163-A4
adjustable

Above Units with CAD installed,

1-Mc Synthesizer
in 100-c steps ... \$3780.
in USA

100-kc Synthesizer
in 10-c steps ... \$3640.
in USA
12-Mc Synthesizer
in 1-kc steps ... \$3780.
in USA
\$500 additional

VERNIER CONTROL makes possible the adjustment of the free-running frequency of the internal master 5-Mc crystal oscillator against an external standard. Synthesizer can also be locked to an external standard.

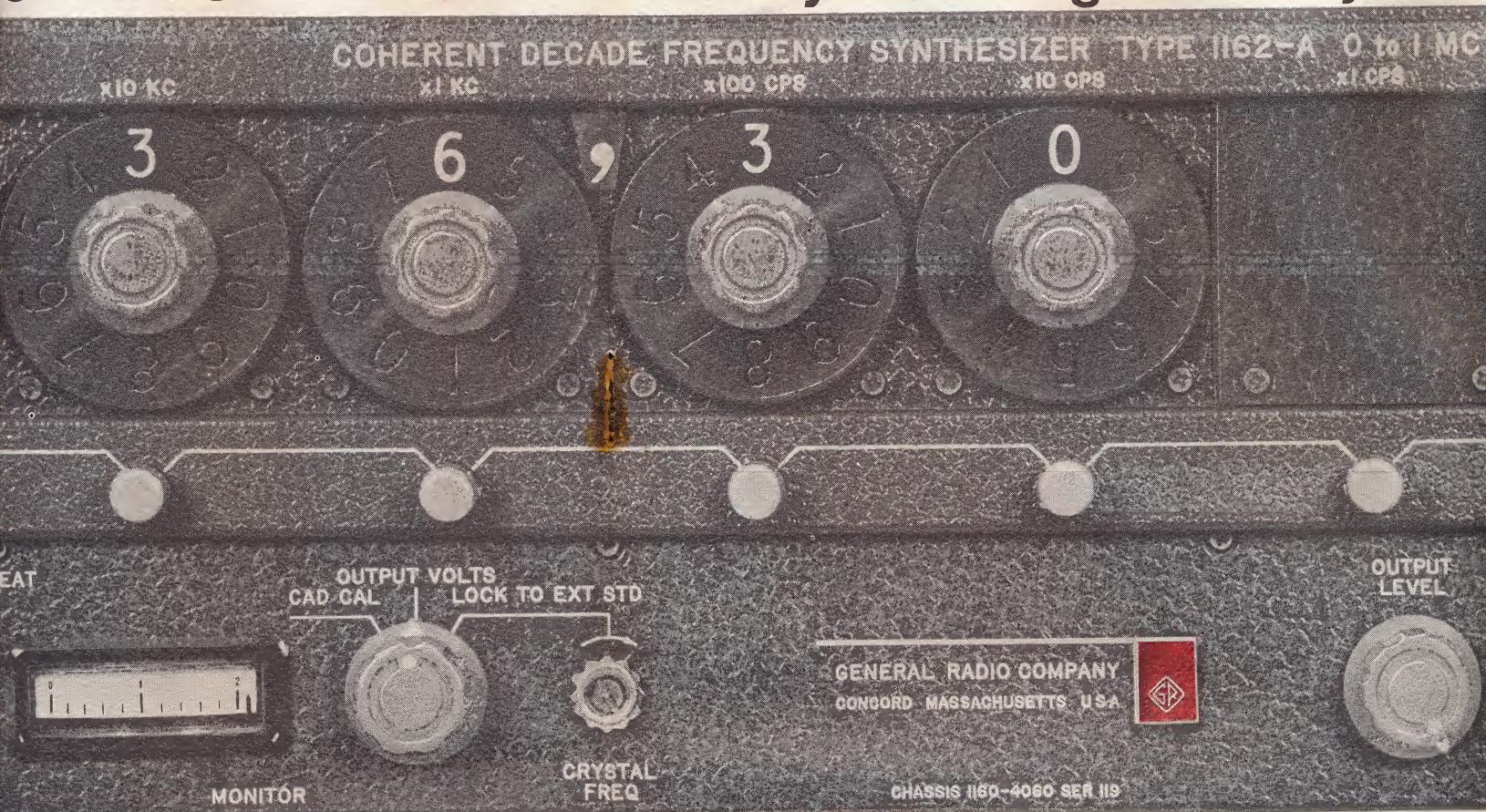
Where best possible long-term stability and freedom from temperature effects are required, the Type 1115-B Standard-Frequency Oscillator is recommended for use as the master crystal oscillator. The room-temperature crystal oscillator of the synthesizer has a typical

temperature coefficient of frequency of $2 \times 10^{-7}/^{\circ}\text{C}$ from 20°C to 50°C as compared to the less than $1 \times 10^{-11}/^{\circ}\text{C}$ specification of the oven-controlled 1115-B. Typical stability is 5×10^{-10} per day. Price of 1115-B, \$2050 in U.S.A.



SIZERS

...Provide Precisely Known Signals in Crystal-



With Five DI Units

Shown above: Type 1162-A5 1-Mc Synthesizer

adjustable in 10-c steps ... \$4220.
in USA

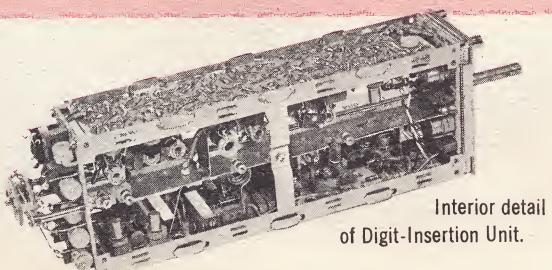
Comparable Type 1161-A5 100-kc Synthesizer

adjustable in 1-c steps ... \$4080.
in USA

or Type 1163-A5 1.2-Mc Synthesizer

adjustable in 100-c steps ... \$4220.
in USA

Above Units with CAD installed, \$500 additional

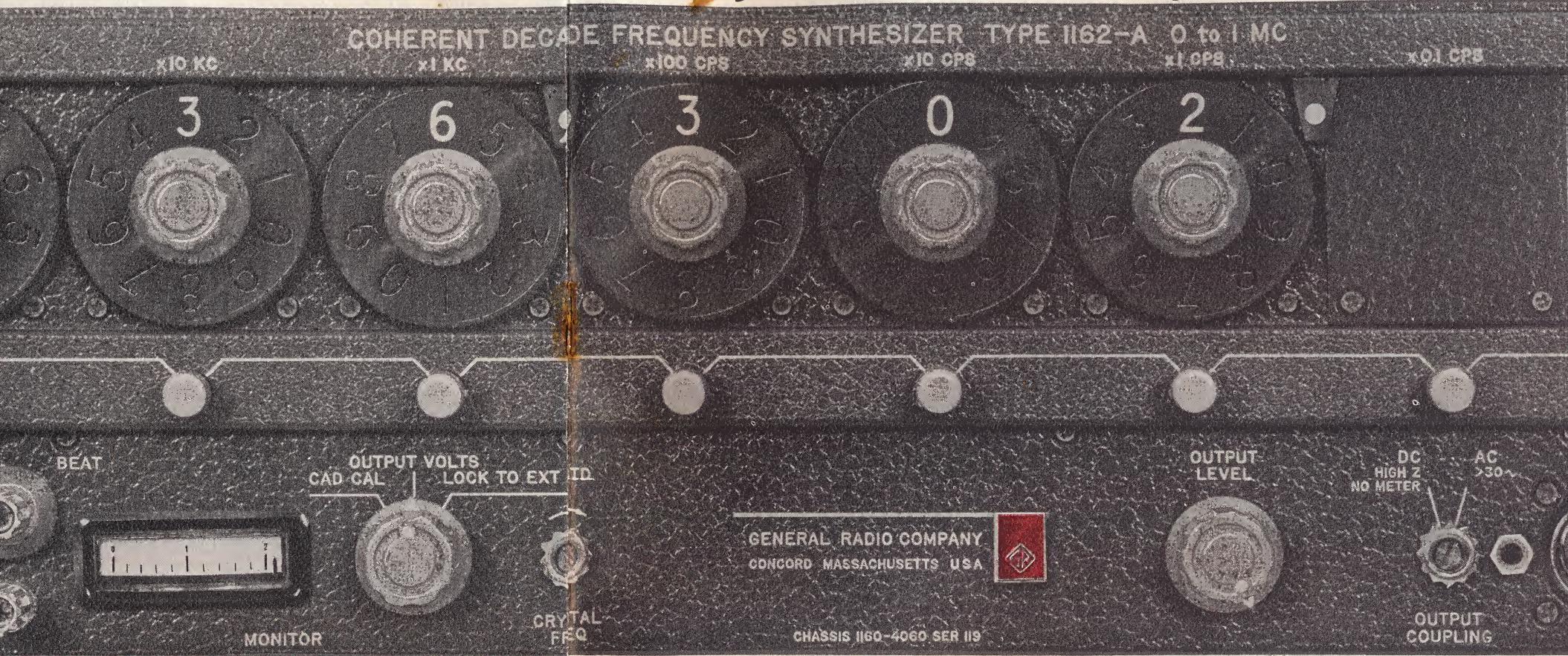


Interior detail
of Digit-Insertion Unit.

Additional DI Units or CAD
plug-in quickly. No special tools
are necessary.



SYNTHESIZERS ...Provide Precisely Known Signals in Crystal-Locked Steps



DI Units

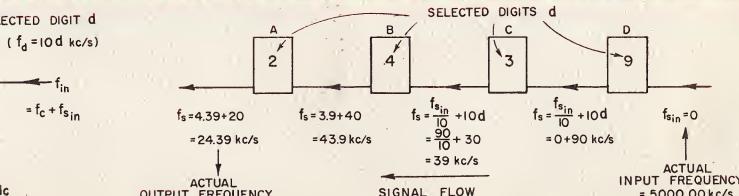
Above: Type 1162-A6 1-Mc Synthesizer

adjustable in 1-c steps... \$4660.

Variable Type 1161-A6 100-kc Synthesizer
adjustable in 0.1-c steps... \$4520.

or Type 1163-A6 12-Mc Synthesizer
adjustable in 10-c steps... \$4660.

In USA
e Units with CAD installed, \$500 additional



Signal passage through four Digit-Insertion Units illustrating synthesis of desired signal component.

The Synthesizing Principle used in GR Synthesizers

Each DI Unit receives an input signal, modifies the frequency slightly in two steps, and delivers it as an input to the next DI Unit. The diagram shows the essential processes performed in the DI Unit.

Each signal (input and output) has a frequency that may be regarded as the sum of two components. The first component is a "carrier" frequency of 5 Mc/s, which remains unchanged as it moves through all the DI Units. The second component is the "signal" component, which always lies between 0 and 100 kc/s.

Mathematically, we denote the total input frequency by

$$f_{in} = f_c + f_{sin} \text{ kc/s} \quad (1)$$

and the output frequency by

$$f_{out} = f_c + f_s \text{ kc/s} \quad (2)$$

The DI Unit performs the following operation:

$$f_{out} = f_c + \frac{f_{sin}}{10} + 10d \text{ kc/s} \quad (3)$$

or

$$f_s = \frac{f_{sin}}{10} + 10d \text{ kc/s} \quad (4)$$

where

f_{in}, f_{out} = total input and output frequencies.

f_c = carrier component, invariant.

f_{sin} = signal component of input.

f_s = signal component of output.

d = selected digit, from 0 to 9 in integral steps.

For convenience in following frequency changes through the train of DI Units, we can disregard the carrier component, since this passes through unchanged, and concentrate only on the signal component,

as in equation (4). The next figure shows four DI Units each with digits selected as indicated, and the signal-component flow through the train, from right to left. Note the correspondence between the signal component of output frequency from Unit A (24.39 kc/s) and the digit-dial settings (2439). It is clear that the output frequency from any Unit in such a train of DI Units will have a signal component that is, in kc/s:

$$f_s = 10d_1 + d_2 + 0.1d_3 + 0.01d_4 + \dots \quad (5)$$

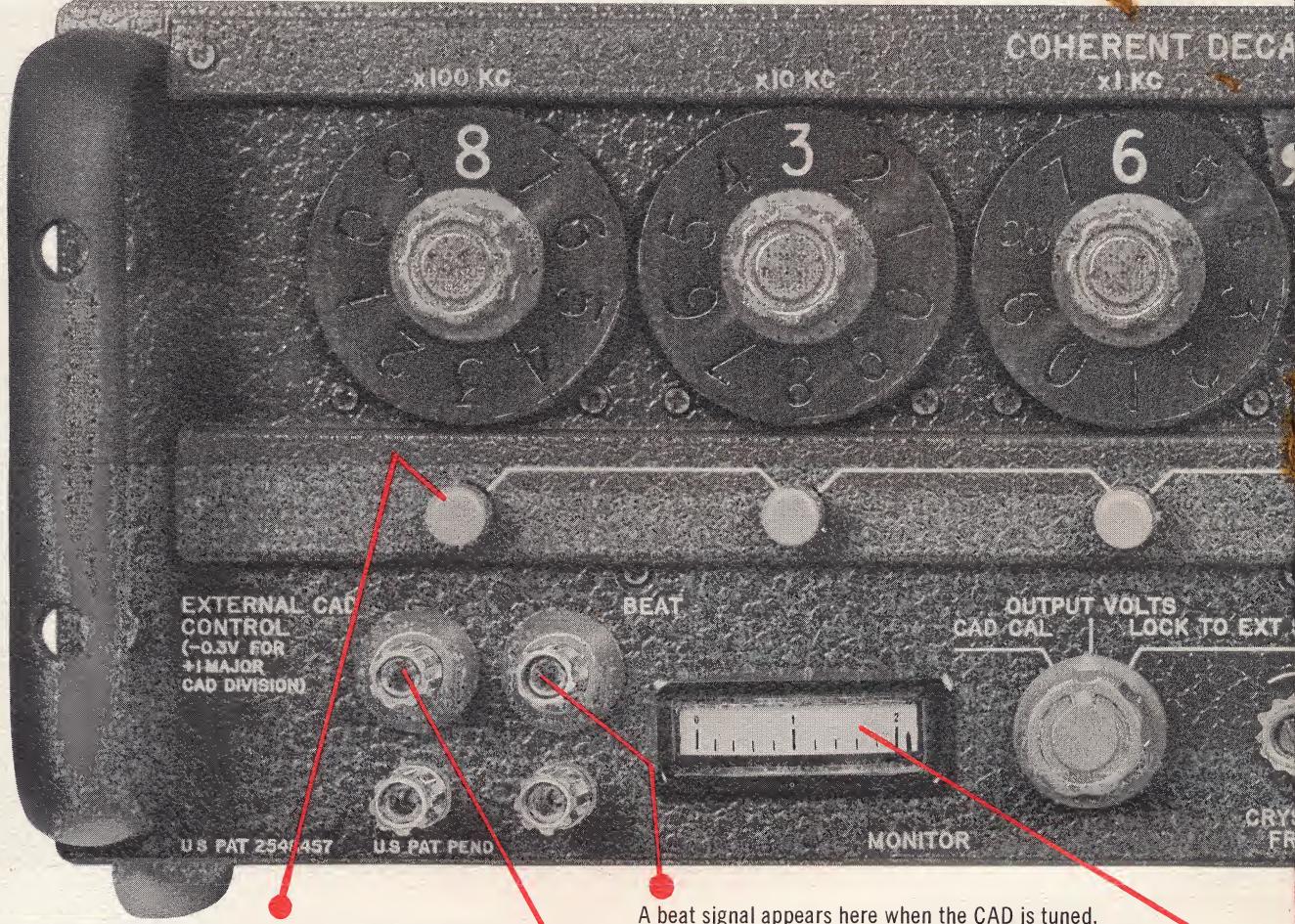
where d_1 represents the selected digit on the engaged DI Unit furthest to the left, and d_2 through d_4 represent digits selected on successive DI Units to the right.

Equation (4) defines the two fundamental operations performed on the signal component by each DI Unit, which permit frequency synthesis in steps as small as may be desired. These operations are:

(1) Divide the input signal component by 10.

(2) Add to this a digit component that is 10 times the selected digit (in kc/s) and pass the result on to the input of the next DI Unit in the train.

EQUENCY SYNTHESIZERS ...Com



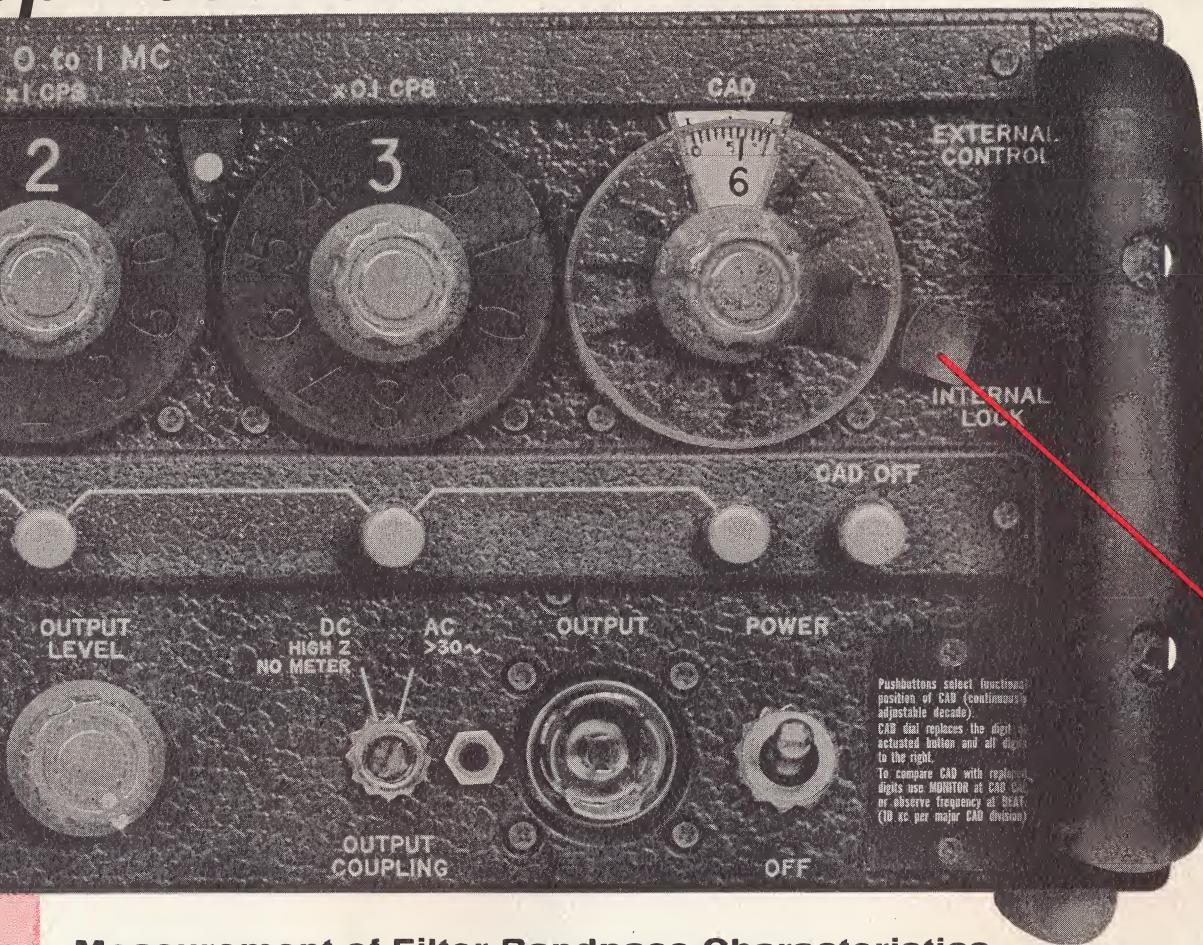
Pushbuttons enable Continuously Adjustable Decade to replace the DI Units' contribution to output frequency. For example, pressing the button below the 100-cycle-per-step decade will replace it and all decades to the right with the CAD . . . CAD will cover a 1-kc range in the region of frequency selected by dials to the left of operated button.

Apply a variable voltage here to sweep CAD electronically. Sweep range is established by pressing the pushbutton below appropriate DI-Unit; i.e., push button below 100-cycle DI to sweep the signal (set on remaining dials to the left) over a 1-kc range. A control signal of -0.3V dc, will shift the CAD frequency upward by the equivalent of one major CAD dial division from actual setting of the CAD dial. With the button under the 100-cycle decade depressed, the synthesizer output frequency will increase by 100 cycles per second for every -0.3V dc. Sweeping range is ± 10 major dial divisions from any starting point within the CAD dial range, or ± 1000 cps in this example.

A beat signal appears here when the CAD is tuned, manually or electronically. This signal is proportional to the difference between CAD frequency and the settings of the replaced digit decades. A beat frequency of 10 kc/s corresponds to an effective difference of one major CAD dial division (or one digit step of the dial above the actuated button).

When switch is set to CAD CAL, this MONITOR meter behaves as an analog frequency meter. As CAD is tuned toward the value set on the disengaged DI dials, meter first reads the frequency difference and then follows the beat frequency directly, thus providing means for accurately adjusting the CAD setting.

For Decades... Plus Continuously-Adjustable Decade



Measurement of Filter Bandpass Characteristics

The measurement of filter bandpass characteristics is an excellent example of the use of the Synthesizer with swept-frequency output.

The frequency of the CAD is swept by means of a variable voltage introduced at the EXTERNAL CAD CONTROL terminals. Waveform of the sweeping signal is relatively unimportant; a sine wave or sawtooth may be used. Markers are derived using the signal available at the BEAT terminals.

In the example shown, the center-frequency marker is formed from the zero beat that occurs when the CAD output frequency coincides with the frequency set on the Digit-Insertion Units replaced by the CAD. To produce the side markers, the frequency at the BEAT terminals is mixed with another frequency, and the mixer output rectified. When 10 kc/s is chosen as the

side-marker generating frequency, markers occur at ± 1 major CAD division and, by harmonic mixing, at ± 2 and ± 3 divisions.

Depending upon which DI button is pushed, marker spacing can represent any output frequency interval from 0.01 c/s to 10 kc/s.

If a different external mixing frequency is used, markers occur at correspondingly different intervals. For instance, 15 kc/s will space the markers by $1\frac{1}{2}$ CAD divisions, and 5 kc/s will space them by $\frac{1}{2}$ division.

In the illustrations, 15 kc/s was injected for Figure 1, and the button under "x1C" was actuated. For Figures 2 and 3, 10 kc/s was supplied to the marker mixer. In Figure 2, the "x1C" button was used, and in Figure 3 the "x10C" button.

This decade (CAD) can be included in any of the Synthesizer versions. It makes possible continuous frequency coverage and provides additional significant figures beyond the resolution of the digital decades. The CAD can also functionally replace one or more of the DI Units. For example, if you press the pushbutton at the 10-cps step position, the CAD replaces the decade directly above the actuated button and all decades to the right; the CAD automatically assumes a 100-cycle range. If the button at the 100-cps step position is pressed, the Continuously Adjustable Decade provides a 1,000-cycle range. This process can be used to replace any number of decades up to 1 Mc/s providing continuous frequency adjustment over a small or large range, as desired. Furthermore, by virtue of a self-calibrating feature of the CAD, frequency can be set precisely to 3 or more significant figures, in terms of the digit dials. Thus, models equipped with the CAD can be set to more significant figures than the number of dials would suggest.

Synthesizers of three or more DI Units can be ordered with or without the CAD. If not included at the outset, the CAD can be added later. Because the CAD provides continuous tuning, sweep capability, additional resolution (3 or more figures) and hence versatility, it is particularly recommended where applications will be varied and unpredictable.



...and Much More



Output, when ac-coupled, is flat within ± 1 dB from 30 c/s to 1 Mc/s, 30 c/s to 100 kc/s for 1161-A models; $\pm 1\frac{1}{2}$ dB from 30 c/s to 12 Mc/s for 1163-A models. Output impedance is 5 ohms, and available output voltage into loads of 50 ohms or higher is in excess of 2 volts, rms.

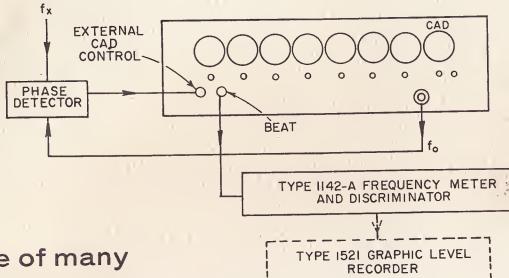
In dc-coupled condition (1161-A and 1162-A only) output impedance is variable from 0 to 3 kilohms, depending on level-control setting. Available open-circuit output voltage is approximately 1 volt.

Please Lift This Flap

To learn more about how versatile this Synthesizer can be with calibrated continuous tuning.

Coherent Decade Frequency Synthesizers

SPECIFICATIONS



One of many
Synthesizer uses...

Measurement of Active Frequency Sources

The block diagram shows how very small frequency changes can be tracked and recorded. The unknown frequency, f_x , is compared in a phase detector with the output frequency, f_o , from the synthesizer. The dc voltage generated in the phase detector is connected to the EXTERNAL-CAD-CONTROL jack of the synthesizer, whereupon the synthesizer output automatically tracks the unknown frequency.

The frequency from the BEAT terminals is measured or recorded. As the synthesizer output frequency varies in response to changes in the unknown frequency, the beat output varies proportionately, the amount of change depending upon which button has been pushed. For example, if the drift is small, the X 1 CPS button might be used. In this case, a change of 1 c/s in the synthesizer output produces a 10-kc change in the recorded beat frequency — a magnification of 10^4 . Smaller or greater magnifications can be realized, as required, merely by selecting other pushbuttons.

| | Type 1161-A | Type 1162-A | Type 1163-A |
|--|---|---|----------------|
| Frequency Range: | 0-100 kc/s | 0-1 Mc/s | 30 c/s-12 Mc/s |
| Smallest Digital Step: | 0.01 c/s | 0.1 c/s | 1 c/s |
| Smallest Direct-Calibrated CAD Increments (A7C-models only): | 0.0001 c/s | 0.001 c/s | 0.01 c/s |
| Max Bandwidth Controllable by CAD: | 100 kc/s | 1 Mc/s | 1 Mc/s |
| RDI-1 Units may be used in: | All digit positions | All except 1-Mc step position | |
| Spurious Frequency Output: | | | |
| Harmonic (at max output): | <-40 dB | <-40 dB | <-34 dB |
| Nonharmonic: | <-80 dB | <-60 dB | <-60 dB |
| Output: | Coupling switch at AC: Adjustable, 0 to 2 V, rms; metered at output receptacle (internal impedance = 7 Ω; min load impedance for full power = 50 Ω). | Output Impedance Switch at 50 Ω: 0-2 V, rms; metered; behind 50 Ω. | |
| | Coupling switch at DC: Adjustable, 0 to 0.8 V, rms; not metered. (Source impedance variable up to about 4 kΩ with level setting.) | Output Impedance switch at 0: 0-2 V, rms; metered at output receptacle after low impedance. | |
| Output Frequency Characteristic: | ±1 dB max, 50 c/s to max frequency (across 50-Ω or higher load, ac-coupled). ±0.2 dB max, 0 to 10 kc/s (dc-coupled). | ±1.5 dB max, 50 c/s to 12 Mc/s 50-Ω load. | |

| Type | Units Included | Calibrated Digits | | Smallest Step (DI Only) | Price† | Programmable/Manual Models | Type | Price† |
|-----------------------|----------------|-------------------|--------|----------------------------|----------|----------------------------|-------------|-----------|
| | | DI Decades Only | + CAD* | | | | | |
| 100-kc Synthesizer | 1161-A7C | 7 DI Units + CAD | 7 | 9 | 0.01 c/s | \$5460.00 | 1161-AR7C | \$6055.00 |
| | 1161-A6C | 6 DI Units + CAD | 6 | 8 | 0.1 c/s | 5020.00 | 1161-AR6C | 5530.00 |
| | 1161-A5C | 5 DI Units + CAD | 5 | 7 | 1.0 c/s | 4580.00 | 1161-AR5C | 5005.00 |
| | 1161-A4C | 4 DI Units + CAD | 4 | 6 | 10 c/s | 4140.00 | 1161-AR4C | 4480.00 |
| | 1161-A3C | 3 DI Units + CAD | 3 | 5 | 100 c/s | 3700.00 | 1161-AR3C | 3955.00 |
| | 1161-A7 | 7 DI Units | 7 | | 0.01 c/s | 4960.00 | 1161-AR7 | 5555.00 |
| | 1161-A6 | 6 DI Units | 6 | | 0.1 c/s | 4520.00 | 1161-AR6 | 5030.00 |
| | 1161-A5 | 5 DI Units | 5 | | 1.0 c/s | 4080.00 | 1161-AR5 | 4505.00 |
| | 1161-A4 | 4 DI Units | 4 | | 10 c/s | 3640.00 | 1161-AR4 | 3980.00 |
| | 1161-A3 | 3 DI Units | 3 | | 100 c/s | 3200.00 | 1161-AR3 | 3455.00 |
| 1-Mc Synthesizer | 1162-A7C | 7 DI Units + CAD | 7 | 9 | 0.1 c/s | \$5600.00 | 1162-AR7C | \$6195.00 |
| | 1162-A6C | 6 DI Units + CAD | 6 | 8 | 1 c/s | 5160.00 | 1162-AR6C | 5670.00 |
| | 1162-A5C | 5 DI Units + CAD | 5 | 7 | 10 c/s | 4720.00 | 1162-AR5C | 5145.00 |
| | 1162-A4C | 4 DI Units + CAD | 4 | 6 | 100 c/s | 4280.00 | 1162-AR4C | 4620.00 |
| | 1162-A3C | 3 DI Units + CAD | 3 | 5 | 1 k/s | 3840.00 | 1162-AR3C | 4095.00 |
| | 1162-A7 | 7 DI Units | 7 | | 0.1 c/s | 5100.00 | 1162-AR7 | 5695.00 |
| | 1162-A6 | 6 DI Units | 6 | | 1 c/s | 4660.00 | 1162-AR6 | 5170.00 |
| | 1162-A5 | 5 DI Units | 5 | | 10 c/s | 4220.00 | 1162-AR5 | 4645.00 |
| | 1162-A4 | 4 DI Units | 4 | | 100 c/s | 3780.00 | 1162-AR4 | 4120.00 |
| | 1162-A3 | 3 DI Units | 3 | | 1 k/s | 3340.00 | 1162-AR3 | 3595.00 |
| 12-Mc Synthesizer | 1163-A7C | 7 DI Units + CAD | 7 | 9 | 1 c/s | \$5600.00 | 1163-AR7C** | \$6110.00 |
| | 1163-A6C | 6 DI Units + CAD | 6 | 8 | 10 c/s | 5160.00 | 1163-AR6C** | 5585.00 |
| | 1163-A5C | 5 DI Units + CAD | 5 | 7 | 100 c/s | 4720.00 | 1163-AR5C** | 5060.00 |
| | 1163-A4C | 4 DI Units + CAD | 4 | 6 | 1 k/s | 4280.00 | 1163-AR4C** | 4535.00 |
| | 1163-A3C | 3 DI Units + CAD | 3 | 5 | 10 kc/s | 3840.00 | 1163-AR3C** | 4010.00 |
| | 1163-A7 | 7 DI Units | 7 | | 1 c/s | 5100.00 | 1163-AR7** | 5610.00 |
| | 1163-A6 | 6 DI Units | 6 | | 10 c/s | 4660.00 | 1163-AR6** | 5085.00 |
| | 1163-A5 | 5 DI Units | 5 | | 100 c/s | 4220.00 | 1163-AR5** | 4560.00 |
| | 1163-A4 | 4 DI Units | 4 | | 1 k/s | 3780.00 | 1163-AR4** | 4035.00 |
| | 1163-A3 | 3 DI Units | 3 | | 10 kc/s | 3340.00 | 1163-AR3** | 3510.00 |

*Direct reading. If CAD is calibrated in terms of the DI step decades, at least one more significant figure can be added.

**The x1 Mc decade is not programmable in the 1163 Models.

| Type | DECADE MODULES | Price† |
|------------|--|----------|
| 1160-DI-1 | Step Decade (DI Unit) | \$450.00 |
| 1160-RDI-1 | Remotely Programmable Decade | 535.00 |
| 1160-CAD | Continuously Adjustable Decade (Including Calibrating Mixer) | 510.00 |

†All prices F.O.B. West Concord, Massachusetts, for orders originating in U.S.A.

U.S. Patent No. 2,548,457. Patents Pending.

IN CANADA: Toronto 247-2171, Montreal (Mt. Royal) 737-3673
IN EUROPE: Zurich, Switzerland — London, England

BOSTON NEW YORK, N.Y., 964-2722 CHICAGO PHILADELPHIA WASHINGTON, D.C. SYRACUSE DALLAS SAN FRANCISCO LOS ANGELES ORLANDO, FLA. CLEVELAND
(W. Concord) 646-0550 (Ridgefield, N.J.) 943-3140 (Oak Park) 848-9400 (Ft. Washington) 646-1600 (Rockville, Md.) 946-1600 454-9323 FL 7-4031 (Los Altos) 948-8233 469-6201 425-4671 886-0150

Printed in U.S.A. Form No. 3120-A 0365 110M



GENERAL RADIO COMPANY

WEST CONCORD, MASSACHUSETTS

NEW PRICE LISTING

Coherent Decade Frequency Synthesizers Bulletin and Type 1164 Ad Reprint

| <u>Catalog No.</u> | <u>Description</u> | <u>New Price in USA</u> |
|--------------------|---|-------------------------|
| 1160-9432 | 1160-CAD Continuously Adjustable Decade | \$ 550.00 |
| 1160-9439 | 1160-DI-1 Step Decade | \$ 455.00 |
| 1160-9479 | 1160-RDI-1 Remotely Programmable Decade | \$ 545.00 |
| 1161-9413 | 1161-A3 Coherent Decade Frequency Synthesizer | \$ 3640.00 |
| 1161-9414 | 1161-A4 Coherent Decade Frequency Synthesizer | \$ 4085.00 |
| 1161-9415 | 1161-A5 Coherent Decade Frequency Synthesizer | \$ 4530.00 |
| 1161-9416 | 1161-A6 Coherent Decade Frequency Synthesizer | \$ 4975.00 |
| 1161-9417 | 1161-A7 Coherent Decade Frequency Synthesizer | \$ 5420.00 |
| 1161-9503 | 1161-AR3 Coherent Decade Frequency Synthesizer | \$ 3910.00 |
| 1161-9504 | 1161-AR4 Coherent Decade Frequency Synthesizer | \$ 4445.00 |
| 1161-9505 | 1161-AR5 Coherent Decade Frequency Synthesizer | \$ 4980.00 |
| 1161-9506 | 1161-AR6 Coherent Decade Frequency Synthesizer | \$ 5515.00 |
| 1161-9507 | 1161-AR7 Coherent Decade Frequency Synthesizer | \$ 6050.00 |
| 1161-9523 | 1161-AR3C Cohernet Decade Frequency Synthesizer | \$ 4450.00 |
| 1161-9524 | 1161-AR4C Coherent Decade Frequency Synthesizer | \$ 4985.00 |
| 1161-9525 | 1161-AR5C Coherent Decade Frequency Synthesizer | \$ 5520.00 |
| 1161-9526 | 1161-AR6C Coherent Decade Frequency Synthesizer | \$ 6055.00 |
| 1161-9527 | 1161-AR7C Coherent Decade Frequency Synthesizer | \$ 6590.00 |
| 1161-9593 | 1161-A3C Coherent Decade Frequency Synthesizer | \$ 4180.00 |
| 1161-9594 | 1161-A4C Coherent Decade Frequency Synthesizer | \$ 4625.00 |
| 1161-9595 | 1161-A5C Coherent Decade Frequency Synthesizer | \$ 5070.00 |
| 1161-9596 | 1161-A6C Coherent Decade Frequency Synthesizer | \$ 5515.00 |
| 1161-9597 | 1161-A7C Coherent Decade Frequency Synthesizer | \$ 5960.00 |
| 1162-9413 | 1162-A3 Coherent Decade Frequency Synthesizer | \$ 3775.00 |
| 1162-9414 | 1162-A4 Coherent Decade Frequency Synthesizer | \$ 4220.00 |
| 1162-9415 | 1162-A5 Coherent Decade Frequency Synthesizer | \$ 4665.00 |
| 1162-9416 | 1162-A6 Coherent Decade Frequency Synthesizer | \$ 5110.00 |
| 1162-9417 | 1162-A7 Coherent Decade Frequency Synthesizer | \$ 5555.00 |
| 1162-9503 | 1162-AR3 Coherent Decade Frequency Synthesizer | \$ 4045.00 |
| 1162-9504 | 1162-AR4 Coherent Decade Frequency Synthesizer | \$ 4580.00 |
| 1162-9505 | 1162-AR5 Coherent Decade Frequency Synthesizer | \$ 5115.00 |
| 1162-9506 | 1162-AR6 Coherent Decade Frequency Synthesizer | \$ 5650.00 |
| 1162-9507 | 1162-AR7 Coherent Decade Frequency Synthesizer | \$ 6185.00 |
| 1162-9523 | 1162-AR3C Coherent Decade Frequency Synthesizer | \$ 4585.00 |
| 1162-9524 | 1162-AR4C Coherent Decade Frequency Synthesizer | \$ 5120.00 |
| 1162-9525 | 1162-AR5C Coherent Decade Frequency Synthesizer | \$ 5655.00 |
| 1162-9526 | 1162-AR6C Coherent Decade Frequency Synthesizer | \$ 6190.00 |
| 1162-9527 | 1162-AR7C Coherent Decade Frequency Synthesizer | \$ 6725.00 |
| 1162-9593 | 1162-A3C Coherent Decade Frequency Synthesizer | \$ 4315.00 |
| 1162-9594 | 1162-A4C Coherent Decade Frequency Synthesizer | \$ 4760.00 |
| 1162-9595 | 1162-A5C Coherent Decade Frequency Synthesizer | \$ 5205.00 |
| 1162-9596 | 1162-A6C Coherent Decade Frequency Synthesizer | \$ 5650.00 |
| 1162-9597 | 1162-A7C Coherent Decade Frequency Synthesizer | \$ 6095.00 |
| 1163-9413 | 1163-A3 Coherent Decade Frequency Synthesizer | \$ 3895.00 |
| 1163-9414 | 1163-A4 Coherent Decade Frequency Synthesizer | \$ 4340.00 |

New Price Listing for Coherent Decade Frequency Synthesizers Bulletin continued

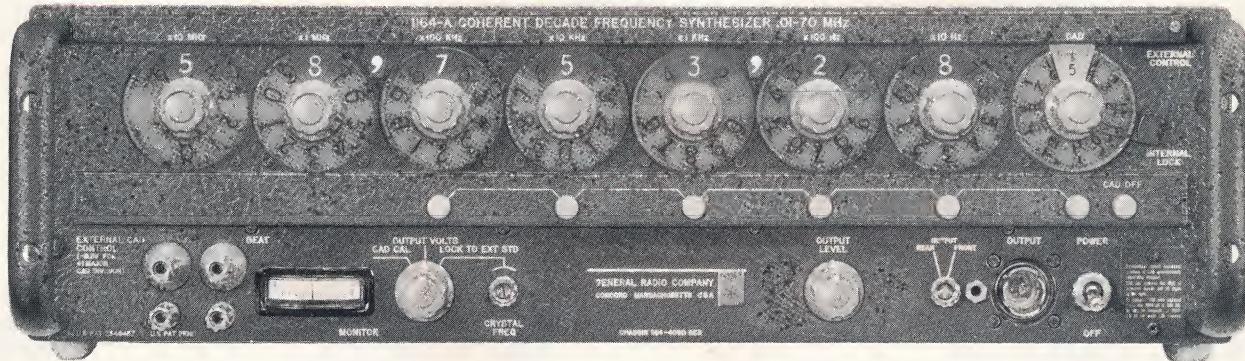
| <u>Catalog No.</u> | <u>Description</u> | <u>New Price in USA</u> |
|--------------------|---|-------------------------|
| 1163-9415 | 1163-A5 Coherent Decade Frequency Synthesizer | \$ 4785.00 |
| 1163-9416 | 1163-A6 Coherent Decade Frequency Synthesizer | \$ 5230.00 |
| 1163-9417 | 1163-A7 Coherent Decade Frequency Synthesizer | \$ 5675.00 |
| 1163-9503 | 1163-AR3 Coherent Decade Frequency Synthesizer | \$ 4075.00 |
| 1163-9504 | 1163-AR4 Coherent Decade Frequency Synthesizer | \$ 4610.00 |
| 1163-9505 | 1163-AR5 Coherent Decade Frequency Synthesizer | \$ 5145.00 |
| 1163-9506 | 1163-AR6 Coherent Decade Frequency Synthesizer | \$ 5680.00 |
| 1163-9507 | 1163-AR7 Coherent Decade Frequency Synthesizer | \$ 6215.00 |
| 1163-9523 | 1163-AR3C Coherent Decade Frequency Synthesizer | \$ 4615.00 |
| 1163-9524 | 1163-AR4C Coherent Decade Frequency Synthesizer | \$ 5150.00 |
| 1163-9525 | 1163-AR5C Coherent Decade Frequency Synthesizer | \$ 5685.00 |
| 1163-9526 | 1163-AR6C Coherent Decade Frequency Synthesizer | \$ 6220.00 |
| 1163-9527 | 1163-AR7C Coherent Decade Frequency Synthesizer | \$ 6755.00 |
| 1163-9593 | 1163-A3C Coherent Decade Frequency Synthesizer | \$ 4435.00 |
| 1163-9594 | 1163-A4C Coherent Decade Frequency Synthesizer | \$ 4880.00 |
| 1163-9595 | 1163-A5C Coherent Decade Frequency Synthesizer | \$ 5325.00 |
| 1163-9596 | 1163-A6C Coherent Decade Frequency Synthesizer | \$ 5770.00 |
| 1163-9597 | 1163-A7C Coherent Decade Frequency Synthesizer | \$ 6215.00 |
| 1164-9413 | 1164-A3 Coherent Decade Frequency Synthesizer | \$ 4745.00 |
| 1164-9414 | 1164-A4 Coherent Decade Frequency Synthesizer | \$ 5190.00 |
| 1164-9415 | 1164-A5 Coherent Decade Frequency Synthesizer | \$ 5635.00 |
| 1164-9416 | 1164-A6 Coherent Decade Frequency Synthesizer | \$ 6080.00 |
| 1164-9417 | 1164-A7 Coherent Decade Frequency Synthesizer | \$ 6525.00 |
| 1164-9503 | 1164-AR3 Coherent Decade Frequency Synthesizer | \$ 4835.00 |
| 1164-9504 | 1164-AR4 Coherent Decade Frequency Synthesizer | \$ 5370.00 |
| 1164-9505 | 1164-AR5 Coherent Decade Frequency Synthesizer | \$ 5905.00 |
| 1164-9506 | 1164-AR6 Coherent Decade Frequency Synthesizer | \$ 6440.00 |
| 1164-9507 | 1164-AR7 Coherent Decade Frequency Synthesizer | \$ 6975.00 |
| 1164-9523 | 1164-AR3C Coherent Decade Frequency Synthesizer | \$ 5375.00 |
| 1164-9524 | 1164-AR4C Coherent Decade Frequency Synthesizer | \$ 5910.00 |
| 1164-9525 | 1164-AR5C Coherent Decade Frequency Synthesizer | \$ 6445.00 |
| 1164-9526 | 1164-AR6C Coherent Decade Frequency Synthesizer | \$ 6980.00 |
| 1164-9527 | 1164-AR7C Coherent Decade Frequency Synthesizer | \$ 7515.00 |
| 1164-9593 | 1164-A3C Coherent Decade Frequency Synthesizer | \$ 5285.00 |
| 1164-9594 | 1164-A4C Coherent Decade Frequency Synthesizer | \$ 5730.00 |
| 1164-9595 | 1164-A5C Coherent Decade Frequency Synthesizer | \$ 6175.00 |
| 1164-9596 | 1164-A6C Coherent Decade Frequency Synthesizer | \$ 6620.00 |
| 1164-9597 | 1164-A7C Coherent Decade Frequency Synthesizer | \$ 7065.00 |

July 1, 1966

GENERAL RADIO COMPANY
West Concord, Massachusetts



NEW 70-MHz Solid-State Synthesizer

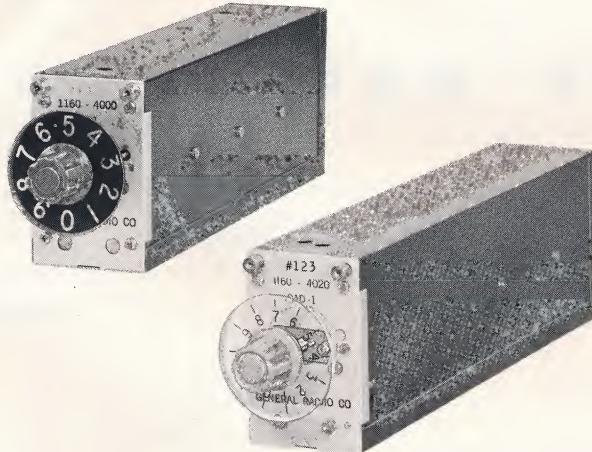


Available in 20 versions. Output adjustable up to 2 volts at accurately known, stable, sine-wave frequencies. 7-digit readout plus continuous frequency control. Signals are coherently synthesized from internal quartz-crystal oscillator. Plug-in modules give you choice of resolution: 10 Hz, 100 Hz, 1 kHz, and 100 kHz, or to better than 0.1 Hz with a continuously adjustable decade.

Basic Synthesizer Modules

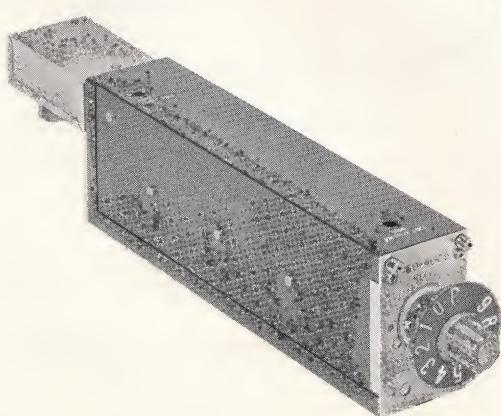
• The DI-1 Unit

Digit-Insertion Module provides discrete frequency steps. This module is used for all digit decades except the 1-MHz and 10-MHz per-step positions.



• The CAD Unit

Continuously Adjustable Decade provides either continuous, manual control of frequency or sweep-frequency coverage of selected sections of the instrument's range up to bandwidths of 1 MHz. It can also readily be calibrated against DI-1 Units to provide additional resolution.



• The RDI-1 Unit

Remotely Programmable Digit-Insertion Module, used in place of the DI-1 Unit, converts the Synthesizer for programmed operation at any or all DI-1 stations. The RDI-1 Unit accepts either a biquinary or 10-line coded program or can be used manually when the dial is turned from the programmable "R" position to the desired digit. A plug is provided at the rear of the module for the programming signal.

SPECIFICATIONS

Frequency Range: 10 kHz to 70 MHz.

Smallest Digital Step: 10 Hz.

Smallest Direct-Reading CAD Increment (A7C model): 0.1 Hz.

Maximum Bandwidth Controllable by CAD: 1.2 MHz.

Maximum Programmable Bandwidth:** 1 MHz.

Spurious Frequency Outputs: Harmonic (at max output), <-30 dB. Nonharmonic, <-60 dB.

Output: 0 to 2 V, rms; metered; behind 50Ω; flat within 0.3 dB from 10 kHz to 70 MHz, available at either front or rear.

Auxiliary Outputs (at rear): Primary outlets, 100 kHz and 5 MHz (0.5 V, rms, min, across 50Ω). Secondary outlets, low-level, high-impedance, 0.1 V, min, across 1 kΩ: 1 MHz, 5 MHz, 5/5.1 MHz, 30 MHz, 42 MHz, 50/51 MHz, 90 MHz,

and +18 V, dc (test point). BEAT output and EXT CAD CONTROL input also duplicated at rear.

Operating Temperature Range: 0 to 50°C.

Internal Frequency Standard: Room-temperature, quartz-crystal oscillator. Temperature coefficient of frequency is typically less than $2 \times 10^{-7}/\text{C}$ from 20°C to 50°C. A front-panel frequency adjustment is provided. Crystal can easily be phase-locked to an external standard.

Lock Signal Input from External Standard (if used): 0.25 V, rms, to 5 V, rms, 5 MHz, or any submultiple down to 100 kHz. Input impedance is approximately 1 kΩ for low-level signals, drops to approximately 50Ω effective at high levels.

Power Required: 105 to 125, 195 to 235, or 210 to 250 V, 50 to 400 Hz, 55 W; or 20 to 28 V, dc, 1.8 A.

CALIBRATED DIGITS

PROGRAMMABLE/MANUAL MODELS**

| Type | Units Included | DI Decades Only | DI Decades + CAD* | Smallest Step (DI Only) | Price | Type | Smallest Programmable Increment | Price |
|----------|------------------|-----------------|-------------------|-------------------------|----------|-----------|---------------------------------|----------|
| 1164-A7C | 7 DI Units + CAD | 7 | 9 | 10 Hz | 6,600.00 | 1164-AR7C | 10 Hz | 7,025.00 |
| 1164-A6C | 6 DI Units + CAD | 6 | 8 | 100 Hz | 6,160.00 | 1164-AR6C | 100 Hz | 6,500.00 |
| 1164-A5C | 5 DI Units + CAD | 5 | 7 | 1 kHz | 5,720.00 | 1164-AR5C | 1 kHz | 5,975.00 |
| 1164-A4C | 4 DI Units + CAD | 4 | 6 | 10 kHz | 5,280.00 | 1164-AR4C | 10 kHz | 5,450.00 |
| 1164-A3C | 3 DI Units + CAD | 3 | 5 | 100 kHz | 4,840.00 | 1164-AR3C | 100 kHz | 4,925.00 |
| 1164-A7 | 7 DI Units | 7 | | 10 Hz | 6,100.00 | 1164-AR7 | 10 Hz | 6,525.00 |
| 1164-A6 | 6 DI Units | 6 | | 100 Hz | 5,660.00 | 1164-AR6 | 100 Hz | 6,000.00 |
| 1164-A5 | 5 DI Units | 5 | | 1 kHz | 5,220.00 | 1164-AR5 | 1 kHz | 5,475.00 |
| 1164-A4 | 4 DI Units | 4 | | 10 kHz | 4,780.00 | 1164-AR4 | 10 kHz | 4,950.00 |
| 1164-A3 | 3 DI Units | 3 | | 100 kHz | 4,340.00 | 1164-AR3 | 100 kHz | 4,425.00 |

*Direct Reading. If CAD is calibrated in terms of the DI step decades, at least one more significant figure can be added.

**The X10 MHz and X1 MHz decade units are not programmable. However, these two decades can be programmed between whole 1-MHz steps (for example, between 11 and 12 MHz, 25 and 26 MHz, 59 and 60 MHz, etc.).

GENERAL RADIO COMPANY

West Concord, Massachusetts 01781

- NEW ENGLAND
22 Baker Avenue
West Concord, Massachusetts 01781
- METROPOLITAN NEW YORK
Broad Avenue at Linden
Ridgefield, New Jersey 07657
- SYRACUSE
Pickard Building, East Molloy Rd.
Syracuse, New York 13211
- PHILADELPHIA
Fort Washington Industrial Park
Fort Washington, Pennsylvania 19034
- WASHINGTON and BALTIMORE
11420 Rockville Pike
Rockville, Maryland 20852
- CHICAGO
6605 West North Avenue
Oak Park, Illinois 60302
- CLEVELAND
5579 Pearl Road
Cleveland, Ohio 44129
- ORLANDO
113 East Colonial Drive
Orlando, Florida 32801
- DALLAS
2600 Stemmons Freeway, Suite 210
Dallas, Texas 75207
- SAN FRANCISCO
626 San Antonio Road
Mountain View, California 94040
- LOS ANGELES
1000 North Seward Street
Los Angeles, California 90038
- TORONTO
99 Floral Parkway
Toronto 15, Ontario, Canada
- MONTREAL
1255 Laird Boulevard
Town of Mt. Royal, Quebec, Canada

GENERAL RADIO COMPANY (OVERSEAS), 8008 Zurich, Switzerland

GENERAL RADIO COMPANY (U.K.) LIMITED, Bourne End, Buckinghamshire, England

REPRESENTATIVES IN PRINCIPAL OVERSEAS COUNTRIES